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$$6^{\lambda}\Sigma N(d)\cdot N\left(\frac{m}{d}\right) = N(m)\cdot N(Pm)\cdot N(P^2m),$$

where the sign of summation extends to all divisors of $m$.

**188. Proposed by ELMER SCHUYLER, Brooklyn, New York.**

Solve the congruence, $3x^2+4x+5\equiv 0$, mod. 20 [Reid].

**189. Proposed by V. M. SPUNAR, Chicago, Ill.**

If $p$ and $p_1=2^p-1$ are primes, then are the numbers of the sequence, $p_1=2^p-1$, $p_2=2^{p_1}-1$, $p_3=2^{p_2}-1$, $\cdots$, $p_n=2^{p_{n-1}}-1$ all primes?

## SOLUTIONS OF PROBLEMS.

### ALGEBRA.

**379. Proposed by C. N. SCHMALL, New York, N. Y.**

Given $y=ax+b$. If the values of $x$ increase in an arithmetical progression, show that the values of $y$ vary likewise.

Solution by T. M. Blakslee, Ames, Iowa.

We have

$$y_1=ax_1+b,\quad y_2=ax_2+b,\quad y_3=ax_3+b,\ \cdots.$$

Hence,

$$y_2-y_1=a(x_2-x_1),\quad y_3-y_2=a(x_3-x_2),\ \cdots.$$

Since $x_1$, $x_2$, $x_3$, $\cdots$, $x_n$ are in an arithmetical progression,

$$x_2-x_1=x_3-x_2=x_4-x_3,\ \cdots,\ =d \text{ say}.$$

Hence,

$$y_2-y_1=y_3-y_2=y_4-y_3,\ \cdots,\ =ad.$$

Hence,

$$y_2=y_1+ad,\quad y_3=y_2+ad=y_1+2ad,$$

$$y_4=y_3+ad=y_1+3ad,\ \cdots,\ y_n=y_1+(n-1)ad,$$

an arithmetical progression whose common difference is $ad$.

Also solved by A. H. Holmes, A. M. Hardin, Elmer Schuyler, W. T. Risley, T. J. Fitzpatrick, and the Proposer.

**380. Proposed by J. K. ELWOOD, Lucas, Kansas.**

A and B set out to walk around a cinder path a mile in circumference, and walk 3 hours, A walking 8 miles farther than B. Each reduced his rate one mile per hour at the end of the first hour, and again one mile per hour at the end of the second hour, his speed being otherwise uniform. They start in the same direction, but 12 minutes after A has passed B the third time he turns and walks in the other direction until 6 minutes after he has met B the third time, when he returns to his original direction, and overtakes B four times more. Determine their initial velocities.

Solution by the Proposer.

A gains $2\frac{2}{3}$ miles an hour, or one mile in 22.5 minutes. He overtakes and passes B the first three times in 67.5 minutes, and the last three times in 67.5 minutes. All of A's travel requiring calculation, therefore, occurs in

$$180-(67.5+67.5)=45 \text{ minutes of the second hour.}$$

Let $x =$ the sum of their rates during second hour.

In the 12 minutes after passing B the third time A gains 8/15 mile. Hence, after A reverses his direction, the three meetings will require them to travel $2\frac{8}{15}$ miles at $x$ miles an hour, or $x/60$ mile per minute. Then $2\frac{8}{15} \div x/60 = 152/x$ is the number of minutes required for the three meetings.

After this they continue in opposite directions 6 minutes, and together travel $x/10$ miles.

*Case I.*—If they do not meet during the 6 minutes, then A, after resuming his original direction, must first gain $x/10$ miles to overtake B, which requires $x/10 \times 22.5$ minutes. Hence

$$12 + \frac{152}{x} + 6 + \frac{x}{10} \times 22.5 = 180 - (67.5 + 67.5) = 45 \text{ minutes.}$$

or,

$$\frac{9x}{4} + \frac{153}{x} = 27, \tag{1}$$

from which $x = 18 \pm \sqrt{-284}$.

*Case II.*—If they meet once during the 6 minutes, then A must gain $(x/10 - 1)$ miles, which he will do in $(x/10 - 1) \times 22.5$ minutes.

Then equation (1) becomes

$$\frac{9x}{4} - 22.5 + \frac{152}{x} = 27, \tag{2}$$

from which $x = 18.31$.

Hence A's rate is now 10.49 miles per hour and B's is 7.82 miles per hour. Then A began walking at 11.49 miles per hour and B at 8.82 miles per hour. In this way a complete time-table has been constructed.

## GEOMETRY.

**407. Proposed by S. LEFSCHETZ, University of Nebraska.**

To construct a right triangle knowing the sum of the sides of the right angle and the sum of one of them and the hypothenuse.

### I. Solution by A. H. Holmes, Brunswick, Maine.

Let $a$ be the sum of the two sides and $b$ be the sum of one side and the hypothenuse of the required triangle. Draw $AB = 2a$ and extend to $C$, making $BC = b - a$. On $AC$ describe the semi-circle, $ACD$. At $B$ erect a perpendicular $BD$ cutting the circumference in $D$. On $DB$ take $DE = BC$. Then $BE$ is one of the required sides. From $O$, the middle point of $AB$, lay off $OF = BE$. Then $BF$ is the other side and $BEF$ is the required triangle. For, letting $x$ and $y$ represent the sides, we have $x + y = a$ and $x + \sqrt{x^2 + y^2} = b$, from which $x = \sqrt{2b(b - a)} - (b - a)$ and $y = b - \sqrt{2b(b - a)}$.